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UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY

FOREST INSECT INVESTIGATIONS

FOREST ENTOMOLOGY AND FOREST MANAGEMENT

By

Dr. J. M. Swaine, Associate Dominion Entomologist,
Department of Agriculture,
Ottawa, Canada.
June, 1925

May have another

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Insect Control

March 31, 1926.

Mr. J. M. Miller,
Box 3010,
Stanford University, California.

Dear Miller:

For your information and files, I am enclosing
a copy of a paper by Doctor Swaine. I am sending a copy of
this paper to Evenden and Craighead.

Very sincerely yours,

A. J. Jaenicke

Enclosure.

A. J. Jaenicke,
Forest Examiner.

Copy for information. Mr. Evenden.

Forest Entomology
and
Forest Management*

By
Dr. J. M. Swaine, Associate Dominion Entomologist,
Department of Agriculture,
Ottawa, Canada.
June, 1925.

*Read before the general forestry session of the ninth annual meeting of the Pacific Division of the American Association for the Advancement of Science, at Portland, Oregon, on June 17, 1925. In the absence of Dr. Swaine, the paper was read by Ralph Hopping, Dominion Forest Entomologist for British Columbia.

A. J. Jaenike.

The importance of forest insect injuries and the practical value of forest insect investigations have come to be appreciated on this continent, only within the last decade. The memory of the destruction caused by a few great forest insect outbreaks, the investigation of a few forest entomologists and the demonstration of practical results through bark-beetle control operations have forced the recognition of forest entomology as an important branch of forestry, with problems that must be dealt with in an extensive plan of forest management.

Forest insect injuries are endemic everywhere throughout our forests, affecting all our species of timber trees more or less seriously, and causing a great total amount of injury that is in large part unavoidable in the present condition of our enormous unmanaged forests. In addition, we have the sporadic and epidemic outbreaks which, in the latter case, may spread very rapidly, often lasting for several or many years, and causing at times, incalculable forest losses.

The most notorious of these outbreaks in recent years have been caused by the Larch Sawfly, the Spruce Budworm, the Western Hemlock Looper, the Forest Tent Caterpillar, the Dendroctonus beetles in pine, spruce and Douglas fir, the Western Cedar Borer, the Eastern White Pine Weevil, and the

Monocheamus beetles in logs and fire-killed trees of pine, spruce and balsam.

Each injurious species has its peculiar relations to the trees which it attacks, and it is, therefore, essential that the taxonomy and biology of the species form a part of the investigation. The systematic and morphologic study of forest insect groups enables us to identify the species concerned and makes available to us the literature dealing with previous investigations and must be recognized as comprising an essential part of the work, not less important in respect to general control work than the study of the life history and habits of the insects.

The life-history often affords an opportunity for successful attack through direct control measures. The Dendroctonus beetles being all in hibernation in the bark attacked during the previous summer, the destruction of the broods in the bark of standing infested trees, logs, slash and stumps previous to the emergence of the beetles may be employed very effectively in their control. The White Pine Weevil, on the other hand, hibernates in the ground or in similar hiding places and its control is a much more difficult matter.

Much important information is obtained through rearing the insects in cages variously adapted to suit the conditions. In connection with our bark-beetle studies we

cage entire infested trees, using separate cages for stump, main trunk and top and branches. Some of these cages are 60 feet long and 8 feet square. There are obtained in this way an exact record of the emergence of the various species assisting in the attack, a definite knowledge of the numbers of beetles emerging from the infested trees and much other valuable data.

RELATION OF INSECT ATTACK TO THE HEALTH OF THE TREES.

Many species of insects feed only on dying or dead trees and are either scavengers or injurious to logs and wood products. Many other species attack the foliage, bark or wood of living healthy trees and injure or kill the trees or their parts. Many will attack successfully trees in a weakened condition but only rarely demonstrate their power to kill healthy trees. There is a great variety of habit in this regard, even within the limits of the same species, depending probably upon factors which are not yet sufficiently well understood. Some insects attack only a few tree species; while others feed more or less readily on several or many trees, the Douglas fir Beetle, for example, confines itself chiefly to the Douglas fir and western larch; the Mountain Pine Beetle, Dendroctonus monticolae, attacks most species of pine within its range. It is suspected that among the latter group races may develop with an inherited preference for the tree species from which they have bred.

THE DEVELOPMENT AND NATURAL CONTROL OF OUTBREAKS

Insect outbreaks present a varied picture and depend upon many factors, some imperfectly understood. Weather conditions play an important part, including temperature, sunlight, moisture content of soil and air, and winds. These factors may act directly on the insects themselves or the effect may be chiefly upon the health of the timber and thus influence the development of insect outbreaks. Storms, at the flight time of the insect may have a very important effect in reducing the outbreak.

Parasites, predaceous insects and birds have an important influence in preventing or checking the multiplication of injurious insects.

The production of large bodies of weakened timber through windfalls, fires and lumbering operations has a marked effect upon the development of outbreaks of bark and wood boring species.

Our studies in Eastern Canada and in British Columbia have persuaded us that extensive windfall and slash from extensive lumbering operations are the most important factors in the development of *Dendroctonus* outbreaks in that country. It has been demonstrated that a sufficient number of *Dendroctonus monticolae* emerge from yellow pine slash in British Columbia to be responsible for the development and spread of extensive

infestations. The neglect of this factor under British Columbia conditions would, we believe, render our control work useless.

Many factors enter into this problem of which the over-crowding of brood trees, the precise food requirements of certain species and the rather general feeding habits of others are further examples.

Studies of these factors are conducted by means of insectary cages and equipment and on temporary and permanent forest sample plots.

CONTROL METHODS

Preventive measures and control measures for forest insects must depend upon the nature of the attack, the habits of insects, the reaction of the trees to the injury and upon the local conditions respecting management of the forest.

In dealing with defoliating insects such as the Spruce Budworm, the Hemlock Looper and the Larch Sawfly, we have no direct method of control. It seems possible that outbreaks of the Budworm and of the Hemlock Looper may in the future be held in check, at least on limited areas of valuable timber, through the distribution of poisoned dusts from air machines. This method has received some consideration but has not yet been tested on an extensive scale. If the danger that at present attends such an operation can be largely removed, it should be feasible to employ this method with valuable results.

The Larch Sawfly, which a generation ago killed nearly all the eastern larch between the Great Lakes and the Atlantic Ocean, has spread westward across Manitoba, Saskatchewan and Alberta, north of the prairies, into northern British Columbia, and is threatening the present tamarac stand in all that enormous country. Native parasites become abundant towards the close of the outbreak; but are not generally effective in saving the trees. More valuable European parasites have been imported by the Entomological Branch and introduced into Manitoba, and it is planned to continue this work and to experiment with the distribution of native species.

The importation and distribution of parasites and the protection of insectivorous birds are promising methods for development and their value should be strongly emphasized.

The injury caused by some of the defoliators depends largely upon the thrift and general condition of the stand and there is considerable assurance that in a forest under proper management these outbreaks would develop less rapidly and would prove much less destructive.

Recent studies of the Spruce Budworm conducted in Eastern Canada have supported this view, and similar exhaustive study of the relations between the insect attack and the development of the timber are believed essential for our further progress with any injurious species.

At least some of these problems will eventually be solved through systems of forest management. It must be evident, however, that owing to the vast extent of the forested area of this continent, many years must elapse before forest management can have more than a local effect in preventing great outbreaks of defoliating insects. Two lines of effort are indicated. Investigators in entomology, mycology and silviculture must cooperate in the study of these problems, so that the results of their investigations can be incorporated into plans for forest management; and, in the meantime, we must utilize every feasible method of direct control that becomes available.

The great outbreaks of *Dendroctonus* beetles that have ravaged the pine forests of western North America for the past twenty years illustrate the essential part that forest entomology must take in the development of forest management in the western pine areas.

We have dealt with these outbreaks, hitherto, by direct control measures. In British Columbia, our yellow pine area has been swept by outbreaks of *Dendroctonus brevicornis* and *Dendroctonus monticola*, and the latter species has been equally destructive in lodgepole pine and western white pine.

Dendroctonus pseudotsugae has also caused extensive injury in Douglas fir. Our control measures have been confined to outbreaks of these three species and they have, we believe, been remarkably successful. We expect that the last of the

extensive infestation in the yellow pine will be under control by the end of the present season, so that only a moderate amount of prevention will be needed in the future.

The method employed has been to cut and burn as nearly as possible all the beetle-infested trees in the outbreak and to require the burning of all yellow pine slash before the emergence of the *Dendroctonus* beetles contained in the bark. Under the conditions that obtain in British Columbia we have found that large numbers of the destructive beetles breed in the stumps, culled and broken trunks, large tops and neglected logs left from logging operations, and we consider slash burning an absolutely necessary part of our control operations. The immediate utilization or destruction of wind thrown and fire injured timber is equally important.

These direct control methods are necessary at the present time in dealing with the bark-beetle outbreaks, and to some extent they will, doubtless, always be employed. It is evident, however, that in a properly managed forest, in which weakened and dying trees were not permitted to accumulate, with efficient fire protection and the rapid disposal of windfalls, infestations of the kind could develop only very rarely. It should be possible, in the future, through forest management based upon the principles of entomology and silviculture to produce a forest practically immune from bark-beetle attack.

It has been possible to deal with only a few phases of this very broad subject; but I have endeavored to establish that the great problems in forest entomology are not purely entomological in their nature, but are quite as truly great problems in forestry. Their solution will involve some of the most difficult and obscure problems in silviculture, and in many cases will require the combined efforts of entomologists, mycologists, plant physiologists, technical foresters and practical lumbermen. The full cooperation of the scientific men dealing with all phases of forestry will bring nearer the time when we, or those who follow us, will raise forest trees when a large part of our forest areas will be utilized to more nearly their full extent, and will be in some measure, a safe place for trees.